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Flexible, low-mass devices and mechanisms actuated by electroactive polymers

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NASA is seeking to reduce the mass, size, consumed power, and cost of the instrumentation used in its future missions. An important element of many instruments and devices is the actuation mechanism and electroactive polymers offer an effective alternative to current actuators. In this study, two families of electroactive polymer (EAP) materials were investigated, including bending ionomers and longitudinal electrostatically driven elastomers. These materials were demonstrated to effectively actuate manipulation devices and a study is underway to enhance the performance of these materials. Tests were made at temperatures as low as -100°C and at pressure of about 1-Torr, which are below Mars conditions, and the results showed significant actuation displacement. To take advantage of these materials capability, several mechanisms were developed including a gripper, manipulator arm and surface wiper. The manipulator arm was made of a composite rod with a lifting actuator consisting of a scrolled rope that is activated longitudinally by an electrostatic field. A gripper was made to serve as an end-effector and it consisted of multiple bending EAP fingers for grabbing and holding such objects as rocks. An EAP surface wiper was developed to operate like a human finger and to demonstrate the potential to remove dust from optical and IR windows as well as solar cells. These EAP driven devices are taking advantage of the large actuation displacement of these materials for applications that have limited requirement for actuation force capability.